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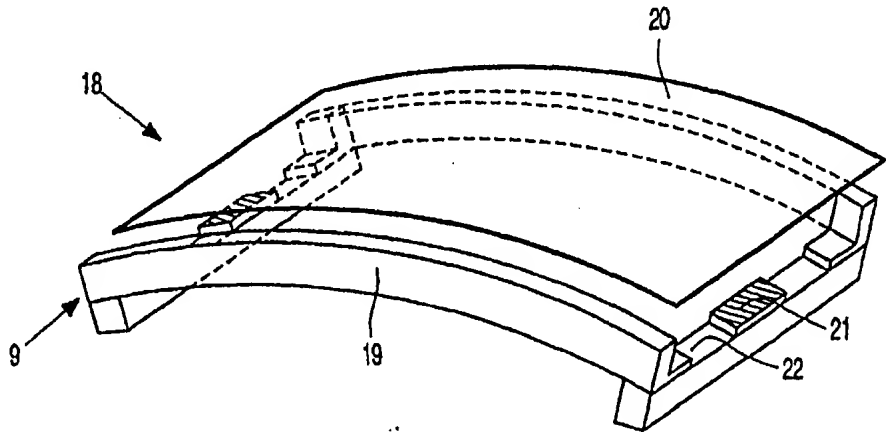

(57) Abstract

The invention relates to a color selection electrode (18) for use in a color cathode ray tube (1), in which the color selection electrode (18) comprises a frame (9) and a mask (20). The frame (9) comprises a pair of mutually opposed support bars (19), metal members (21) and a pair of resilient support members (22) attached between the support bars (19). The metal members (21) have a thermal expansion coefficient smaller than the resilient support members (22) and are connected to the resilient support members (22) on surfaces thereof facing the display screen (8). This construction prevents the mask (20) from being tensed beyond the elastic yield limited and from becoming permanently plastically deformed during further thermal processing of the cathode ray tube (1).

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Color selection electrode for color display tubes.

The invention relates to a color display tube comprising means for generating a plurality of electron beams, a display screen having areas luminescing in different colors and a color selection electrode including a mask having apertures for associating each electron beam with luminescent areas of one color, the mask being tensed on a supporting frame including a pair of mutually opposed support bars and a pair of resilient support members attached between the support bars.

The invention further relates to a color selection electrode and to a color selection electrode supporting frame.

Color cathode ray tubes are known and are used in televisions and computer monitors. A color selection electrode for such a color cathode ray tube is known from EP-0 393 488 A2, in which metal members which have a larger thermal expansion coefficient than the resilient support members are connected to the reverse surfaces of the resilient support members opposite the side to which the color selection electrode is attached.

A color cathode ray tube with a color selection electrode usually comprises a display screen having a pattern of lines or dots of an electroluminescent material, and an electron gun for generating electron beams, in which the color selection electrode, which may comprise a wire mask or an apertured mask, is arranged between the electron gun and the display screen. The mask is a thin metal foil having a large number of apertures and should be arranged very accurately and closely to the display screen so that the mask apertures are systematically aligned with respect to the lines or dots on the display screen. To maintain the systematic alignment, the mask should be suspended in the color display tube in an appropriate manner in order that the mask remains in an accurately determined position both during its manufacture and during operation of the tube. To realize this, a frame supporting the mask and being suspended in the tube is used. The frame is in general rectangular of shape. The frame comprises a pair of support bars disposed in parallel to each other with a predetermined space there between. Resilient support members, which may be substantially U-shaped, are attached

between the ends of the support bars. Metal members may be connected to the frame to give the mask a certain stress relieve during further high temperature processing.

In manufacturing the color selection electrode the mask is stretched under pressure and then connected to the frame, while the tension at the mask is maintained. During the processing and the operation of the display tube, however, temperature differences occur between the mask and the supporting frame which can increase or decrease the tension of the mask. During the cooling ranges of a number of process steps, for example bonding components of the envelope together and evacuating the display tube, the supporting frame will be warmer than the mask. This causes such a great difference in expansion between the supporting frame and the tensed mask that the tension in the mask in this stage may become larger than the elastic yield stress (i.e. the elastic limit) of the mask, as a result of which it may be deformed permanently. After cooling the adhered or evacuated display tube the deformed mask is slack in the supporting frame. As a consequence mislanding occurs, i.e. each electron beam is not properly associated with luminescent areas of one color.

It is an object of the invention to provide a color cathode tube having a color selection electrode mask which is secured to a supporting frame with a tension which is as large as possible, in which differences in thermal expansion between the mask and the supporting frame can be permitted without the tension of the mask becoming larger than the elastic yield stress of the mask.

According to the invention, a color cathode ray tube of the kind mentioned in the opening paragraph is characterized in that the supporting frame further includes metal members having a smaller thermal expansion coefficient than that of the resilient support members and being connected to surfaces of the resilient support members on surfaces thereof facing the display screen.

Since the metal members have a thermal expansion coefficient smaller than the resilient support members, during heat treatment of the color selection electrode the metal members will cause a bending of the resilient support members into the direction of the mask. This bending of the resilient support members reduces the tension which is exerted to the mask and prevents the tension exerted to the mask to reach the level of the plastic deformation stress.

An embodiment of a color display tube according to the invention is characterized in that the resilient support members have a thermal expansion coefficient in the range of 1.5 x

10^{-6} to 15 x 10^{-6} $(°C)^{-1}$ and the metal members have a thermal expansion coefficient in the range of 1 x 10^{-6} to 10 x 10^{-6} $(°C)^{-1}$. In this embodiment metal members having a lower thermal expansion are attached by welding or other suitable means to surfaces of the resilient support members which are facing the display screen. In this structure during thermal processing of the color selection electrode the mask will not be subject to stresses above the elastic yield stress and plastic deformation of the mask is prevented.

A further embodiment of a color display tube according to the invention is characterized in that the resilient support members have a thermal expansion coefficient of 11 x 10^{-6} $(°C)^{-1}$ and the metal members have a thermal expansion coefficient in the range of 6 x 10^{-6} to 8 x 10^{-6} $(°C)^{-1}$. It has appeared to be advantageously to use a frame comprising mainly iron, which typically has a thermal expansion coefficient of 11 x 10^{-6} $(°C)^{-1}$. Such a frame has the advantage of being stiff. In that case a good materials choice for the metal members may be an alloy of nickel and iron. A suitable choice for the alloy composition for the metal members may be a nickel content of 43 to 50 %, leading to a thermal expansion coefficient in the range of 6 x 10^{-6} to 8 x 10^{-6} $(°C)^{-1}$.

Another embodiment of a color display tube according to the invention is characterized in that the resilient support members have a thermal expansion coefficient in the range of 1.5 x 10^{-6} to 6 x 10^{-6} $(°C)^{-1}$ and the metal members have a thermal expansion coefficient in the range of 1 x 10^{-6} to 2 x 10^{-6} $(°C)^{-1}$. A good materials choice for both the frame and the mask is an alloy of nickel and iron, which has the advantage to result in a more elastic mask and consequently a lighter frame construction. In that case the designer of a cathode ray tube may use an alloy of nickel and iron for the metal members with a nickel content of about 36% (so-called technical Invar). This grade nickel iron alloy has the advantage that it may contain some additional impurities and therefor will be cheaper. Such a nickel content in the alloy will give rise to a thermal expansion coefficient of the metal members of about 1.1 x 10^{-6} $(°C)^{-1}$.

A further embodiment of a color display tube according to the invention is characterized in that the metal members comprise an alloy of iron and nickel. Using alloys of iron and nickel and varying the composition of the alloy, provides the display designer with a wide range of material properties that can be tuned precisely to the application.

These and other aspects of the invention will be elucidated with reference to the embodiments described hereinafter.

In the drawings,

Fig. 1 is a side elevation, partly broken away, of a color display tube with a color selection electrode;

Fig. 2 is an elevational view of a color selection electrode according to the invention; and

Fig. 3 is a side view of a color selection electrode according to the invention.

The cathode ray tube 1 shown in Fig. 1 comprises an evacuated glass envelope 2 with a neck 4, a funnel-shaped part 6 and a front panel 7 having an inner surface on which a pattern of, for example lines or dots of phosphor luminescing in different colors (for example red, green and blue) may be arranged. A rectangular frame 9 supports a thin mask 20 at a small distance from the display screen 8. The mask 20 may be an apertured mask having circular or elongate apertures, or a wire mask. During operation of the tube an electron gun system 3 arranged in the tube neck sends electron beams through the mask to the display screen so that the phosphors will emit light. A deflection device 5 ensures that the electron beams systematically scan the display screen.

Figs. 2 and 3 show a color selection electrode 18 according to the invention, comprising a single curved mask 20, a supporting rectangular metal frame 9, comprising a pair of mutually opposed support bars 19 and a pair of resilient support members 22 attached between the support bars 19. Onto the frame 9 the mask 20 is clamped and metal members 21 are connected to the resilient support members 22 by welding or any other suitable connection means on the side of the resilient support members 22 which faces the display screen 8. The metal members 21 have a thermal expansion coefficient smaller than that of the resilient support members 22 so that during heat treatment of the color selection electrode 18 the metal members 21 will cause a bending of the resilient support members 22 into the direction of the mask 20. This bending of the resilient support members 22 reduces the tension which is exerted to the mask 20 and prevents the tension exerted to the mask 20 from reaching the level of the plastic deformation stress. Consequently, when the color selection electrode 18 is placed in a normal temperature state after high temperature processing of the cathode ray tube 1, high tension on the mask 20 will be exerted again. Therefore after completion of the manufacturing

of a color cathode ray tube 1, the tube will show good performance with respect to the landing characteristics, i.e. each electron beam is properly associated with luminescent areas of one color.

If the frame 9 comprises iron parts, which is often the case and results in a very stiff construction of the frame 9, a suitable materials choice for the metal members 21 is an alloy of nickel and iron, with a nickel content in the range of 43% to 50%. Such an alloy of nickel and iron will have a thermal expansion coefficient in the range of 6×10^{-6} to 8×10^{-6} $(°C)^{-1}$. Iron, usually has a thermal expansion coefficient around 11×10^{-6} $(°C)^{-1}$. Such a materials choice leads to a combination of frame 9 and metal members 21 in which a stress relieve of the mask occurs during high temperature processing.

The designer of cathode ray tubes may use a frame 9 comprising an alloy of nickel and iron, having a nickel content in the range of 37% to 43%, which leads to a thermal expansion coefficient in the range of 1.5×10^{-6} to 6×10^{-6} $(°C)^{-1}$. The metal members 21 in this case may comprise an alloy of nickel and iron, having a nickel content in the order of 36%, resulting in a thermal expansion coefficient of about 1.1×10^{-6} $(°C)^{-1}$.

In summary the invention relates to a color selection electrode 18 for use in a color cathode ray tube 1, in which the color selection electrode 18 comprises a frame 9 and a mask 20. The frame 9 comprises a pair of mutually opposed support bars 19, metal members 21 and a pair of resilient support members 22 attached between the support bars 19. The metal members 21 have a thermal expansion coefficient smaller than the resilient support members 22 and are connected to the resilient support members 22 on surfaces thereof facing the display screen 8. This construction prevents the mask 20 from being tensed beyond the elastic yield limited and from becoming permanently plastically deformed during further thermal processing of the cathode ray tube 1.

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The word "comprising" does not exclude the presence of other elements or steps than those listed in a claim.

CLAIMS:

1. A color display tube (1) comprising:
means for generating a plurality of electron beams;
a display screen (8) having areas luminescing in different colors; and
a color selection electrode (18) including a mask (20) having apertures for associating each electron beam with luminescent areas of one color, the mask (20) being tensed on a supporting frame (9) including a pair of mutually opposed support bars (19) and a pair of resilient support members (22) attached between the support bars (19);
characterized in that the supporting frame (9) further includes:
metal members (21) having a smaller thermal expansion coefficient than that of the resilient support members (22) and being connected to surfaces thereof facing the display screen (8).

2. A color display tube (1) according to claim 1
characterized in that
the resilient support members (22) have a thermal expansion coefficient in the range of 1.5×10^{-6} to 15×10^{-6} $(°C)^{-1}$ and
the metal members (21) have a thermal expansion coefficient in the range of 1×10^{-6} to 10×10^{-6} $(°C)^{-1}$.

3. A color display tube (1) according to claim 2
characterized in that
the resilient support members (22) have a thermal expansion coefficient of 11×10^{-6} $(°C)^{-1}$ and
the metal members (21) have a thermal expansion coefficient in the range of 6×10^{-6} to 8×10^{-6} $(°C)^{-1}$.

4. A color display tube (1) according to claim 2
characterized in that
the resilient support members (22) have a thermal expansion coefficient in the range of 1.5×10^{-6} to 6×10^{-6} $(°C)^{-1}$ and

the metal members (21) have a thermal expansion coefficient in the range of 1×10^{-6} to 2×10^{-6} $(°C)^{-1}$.

5. A color display tube (1) according to claim 1 characterized in that the metal members (21) comprise an alloy of iron and nickel.

6. A color selection electrode (18) including a mask (20) being tensed on a supporting frame (9) including a pair of mutually opposed support bars (19) and a pair of resilient support members (22) attached between the support bars (19); characterized in that the supporting frame further includes: metal members (21) having a smaller thermal expansion coefficient than that of the resilient support members (22) and being connected to the resilient support members (22).

7. A color selection electrode supporting frame (9) including a pair of mutually opposed support bars (19) and a pair of resilient support members (22) attached between the support bars (19); characterized in that the supporting frame further includes: metal members (21) having a smaller thermal expansion coefficient than that of the resilient support members (22) and being connected to the resilient support members (22).

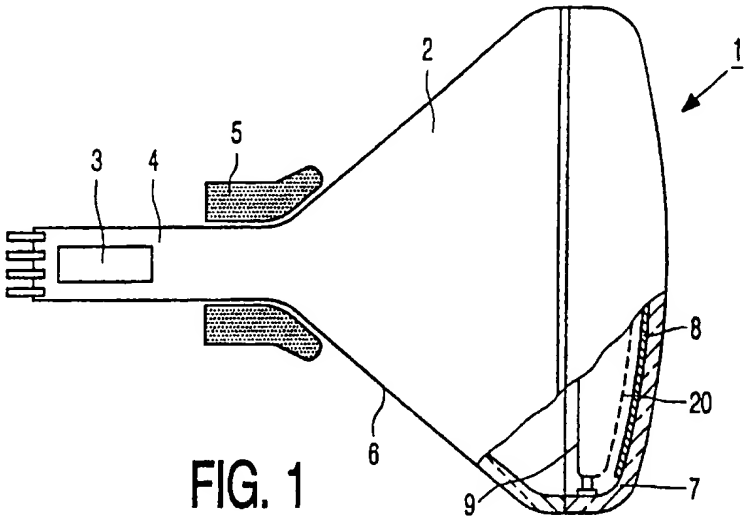

FIG. 1

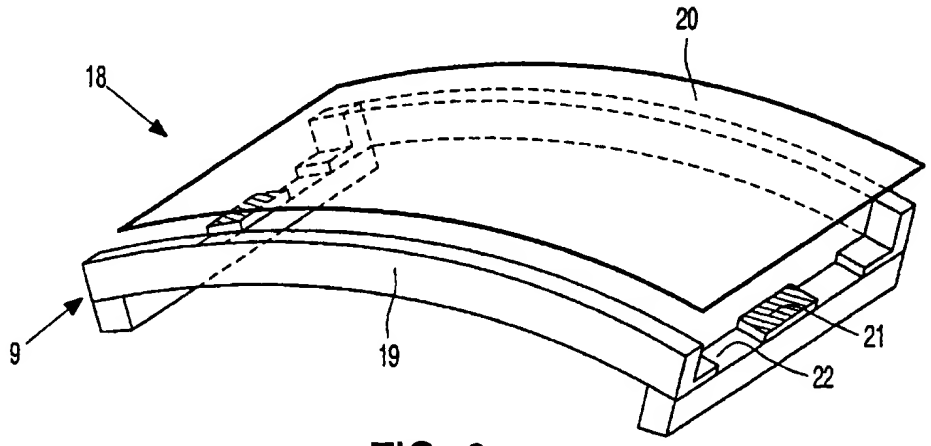

FIG. 2

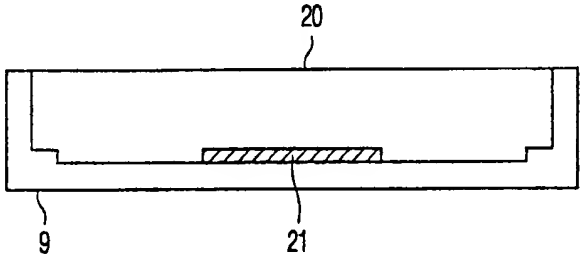

FIG. 3

INTERNATIONAL SEARCH REPORT

Inter ›nal Application No
PCI/EP 99/05772

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01J29/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 393 488 A (SONY CORP) 24 October 1990 (1990-10-24) cited in the application ---	1
P,A	WO 98 48438 A (THOMSON CONSUMER ELECTRONICS) 29 October 1998 (1998-10-29) claims 6-10 ---	1
A	GB 2 303 735 A (SAMSUNG DISPLAY DEVICES CO LTD) 26 February 1997 (1997-02-26) ---	
P,A	EP 0 911 857 A (SONY CORP) 28 April 1999 (1999-04-28) claims 1-9 -----	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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7 October 1999	14/10/1999

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. ional Application No
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